

**REMARKS**

Applicant concurrently files herewith an Excess Claim Fee Payment Letter for three (3) excess total claims.

As a preliminary matter Applicant's representative would like to thank Examiner Jerome Jackson for courtesies extended in the productive personal interview conducted at the U.S. Patent and Trademark Office on July 28, 2004.

In the interview Applicant's representative provided a detailed explanation of the claimed invention and pointed out to the Examiner each of the claimed elements which are neither disclosed nor suggested by the prior art. Furthermore, Applicant's representative pointed out the difference between the convex light trapping member of the claimed invention and the reflective free standing columns of Dawson and the phosphor layer of Hata.

Although the Examiner indicated that neither Dawson nor Hata taught or suggested a "light trapping member" as recited by the claimed invention, the Examiner indicated that it was necessary to amend the claims to overcome the rejections. Applicant respectfully disagrees with the Examiner.

Claims 1-2 and 6-26 are all of the claims presently pending in the application. Claims 1, 2 and 6 have been amended to more particularly define the invention. Claims 7-26 have been added to claim additional features of the invention and to provide varied protection of the present invention.

It is noted that the claim amendments are made only for more particularly pointing out the invention, and not for distinguishing the invention over the prior art, narrowing the claims or for any statutory requirements of patentability. Further, Applicant specifically states that no amendment to any claim herein should be construed as a disclaimer of any interest in or right to an equivalent of any element or feature of the amended claim.

Claims 1, 2, and 6 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Dawson et al. (WO 99/53578) (hereinafter "Dawson"). Claims 1, 2, and 6 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Hata (U.S. Patent Publication No. 2002/0074558).

These rejections are respectfully traversed in the following discussion.

## I. THE CLAIMED INVENTION

The claimed invention (e.g., as defined by exemplary claim 1) is directed to a III group nitride system compound semiconductor light emitting element. The light emitting element includes a transparent substrate, a III group nitride system compound semiconductor formed on a surface of the transparent substrate and a convex light trapping member that is formed over the surface of the transparent substrate. The convex light trapping member has a refractive index that is substantially equal to a refractive index of the transparent substrate or is closer to the refractive index of the transparent substrate than a refractive index of the III group nitride system compound semiconductor layer.

Conventional III group nitride system compound semiconductor layers are grown on a mirror-finished surface of a sapphire substrate to form a light emitting element. Because of the large difference in refractive index between the sapphire substrate and the III group nitride system compound semiconductor layer, the critical angle at the interface of the sapphire substrate and the semiconductor layer is no more than approximately 47 degrees. Therefore, some component of light emitted from the semiconductor layer can be returned to the semiconductor layer after being subjected to total reflection at the interface. This prevents light emitted from the semiconductor layer from being taken out efficiently.

The claimed invention of exemplary claim 1, on the other hand, provides a convex light trapping member that is formed over the surface of the transparent substrate. The convex light trapping member has a refractive index that is substantially equal to a refractive index of the transparent substrate or that is closer to the refractive index of the transparent substrate than a refractive index of the III group nitride system compound semiconductor layer (e.g., see Application at page 3, line 29 through page 4, line 12).

Thus, light entering into the light trapping member is directly transmitted through the transparent substrate and discharged outside of the substrate (e.g., see Application at page 9, lines 1-3). This allows the claimed invention to improve the light extraction efficiency in the direction of the transparent substrate (e.g., see Application at page 14, lines 4-5).

## II. THE PRIOR ART REFERENCE

### A. The Dawson Reference

The Examiner alleges that Dawson teaches the claimed invention of claim 1, 2 and 6. Applicant submits, however, that there are elements of the claimed invention which are neither taught nor suggested by Dawson.

That is, Dawson does not teach or suggest “*a convex light trapping member that is formed on a surface of the transparent substrate, wherein the light trapping member has a refractive index substantially equal to a refractive index of the transparent substrate or closer to the refractive index of the transparent substrate than a refractive index of the III group nitride system compound semiconductor layer*” (emphasis Applicant’s) as recited in independent claim 1, and similarly in independent claim 6.

As noted above, the inventive convex light trapping member is formed over the surface, and has a refractive index that is substantially equal to a refractive index of the transparent substrate or is closer to the refractive index of the transparent substrate than a refractive index of the III group nitride system compound semiconductor layer. As a result, light entering into the light trapping member can be directly transmitted through the transparent substrate and discharged outside of the substrate (e.g., see Application at page 9, lines 1-3), thereby improving the light extraction efficiency in the direction of the transparent substrate.

The novel combination of features of the claimed invention is not taught or suggested by Dawson. Indeed, the Examiner attempts to rely on the array of free standing columns (50) of Dawson to support his allegations as teaching the inventive “convex light trapping member”. The Examiner, however, is clearly incorrect.

Dawson merely discloses a sapphire substrate (12) having a GaN buffer layer (13) grown on the substrate (12). An array of free standing columns (50) of a dielectric multi-layer coating (32) including alternate layers of silica (42) and titanium dioxide (44) is grown on the buffer layer (13) (see Dawson at page 9, lines 15-18; and page 10, lines 7-17).

Nowhere, however, in this passage (nor anywhere else for that matter) does Dawson teach or suggest a convex light trapping member that is formed over a surface of the

transparent substrate. In fact, the array of free standing columns (50) teaches a light reflecting member. The large index of refraction of the dielectric coating (32) rapidly increases the peak reflectivity of the dielectric coating (32) (see Dawson at page, 9, lines 31-34). This allows the columns (50) to act as a mirror (14) to reflect light, not to trap light (see Dawson at page 10, lines 16-17). As shown in Figures 1a, 1b, 1c, 2i and 6, the light is reflected away from the substrate (12) and not trapped and transmitted through the substrate.

Furthermore, Dawson does not even mention a relationship between the refractive indices of the transparent substrate, the light trapping member and the semiconductor layer, let alone teach or suggest that the light trapping member has a refractive index substantially equal to a refractive index of the transparent substrate or closer to the refractive index of the transparent substrate than a refractive index of the III group nitride system compound semiconductor layer, as recited in claim 1, and similarly in claim 6.

Furthermore, the Examiner erroneously attempts to rely on Dawson as teaching a convex light trapping member having an index of refraction of approximately 1.8. Dawson merely teaches that the refractive index of silica at 450nm is approximately 1.55 and that the refractive index of titanium dioxide at 450nm is approximately 2.81, giving a refractive index ratio of approximately 1.8. The ratio of 1.8 is a comparison between the refractive index of titanium dioxide and the refractive index of silica. A refractive index ratio of 1.8 is different from a refractive index of 1.8. Dawson does not teach or suggest a convex light trapping member having a refractive index of 1.8.

Therefore, Applicant submits that there are elements of the claimed invention that are not taught or suggested by Dawson. Therefore, the Examiner is respectfully requested to withdraw this rejection.

### **B. The Hata Reference**

The Examiner alleges that Hata teaches the claimed invention of claims 1, 2 and 6. Applicant submits, however, that there are elements of the claimed invention which are neither taught nor suggested by Hata.

That is, Hata does not teach or suggest “*a convex light trapping member that is*

*formed on a surface of the transparent substrate, wherein the light trapping member has a refractive index substantially equal to a refractive index of the transparent substrate or closer to the refractive index of the transparent substrate than a refractive index of the III group nitride system compound semiconductor layer” as recited in independent claim 1, and similarly in independent claim 6.*

The Examiner attempts to rely on Figure 1 and paragraphs [0031] to [0034] of Hata to support his allegations. The Examiner, however, is clearly incorrect.

Hata merely discloses a sapphire substrate (1) having a buffer layer (31) and an N-type nitride gallium type compound semiconductor layer (3) disposed thereon. The N-type nitride gallium type compound semiconductor layer (3) provides a light emitting layer (4). A phosphor layer (2) coated with a transparent conductor film is provided between the semiconductor layer (3) and the sapphire substrate (1) (see Hata at page 3, paragraph [0043]).

Nowhere, however, in this passage (nor anywhere else for that matter) does Hata teach or suggest a convex light trapping member that is formed over a surface of the transparent substrate. Indeed, the “convex” light trapping member (2) relied upon by the Examiner is actually a phosphor layer (2) (see Hata at page 3, paragraph [0043]). The phosphor layer (2) allows the light emitting layer to emit multi-colored light by excitation of the light emitted from the light emitting layer (see Hata at page 2, paragraph [0031]). Through phosphorescence, the phosphor layer allows the light emitting element to convert the wavelength of emitted light (see Hata at page 3, paragraph [0049]). Hata does not teach trapping light to directly transmit that light through a transparent substrate, as taught by the claimed invention. Hata teaches providing a phosphor layer to excite light emitted from a light emitting layer so that multi-colored light can be emitted by the excitation.

The claimed invention, on the other hand, improves the light extraction efficiency in the direction of the transparent substrate by having light entering into the light trapping member directly transmitted through the transparent substrate and discharged outside of the substrate by providing a light trapping member having a refractive index that is substantially equal to a refractive index of the transparent substrate.

Furthermore, Hata does not mention a relationship between the refractive indices of

the transparent substrate, the light trapping member and the semiconductor layer, let alone teach or suggest that the light trapping member has a refractive index substantially equal to a refractive index of the transparent substrate or closer to the refractive index of the transparent substrate than a refractive index of the III group nitride system compound semiconductor layer, as recited in claim 1 and similarly in claim 6.

Therefore, Applicant submits that there are elements of the claimed invention that are not taught or suggest by Hata. Therefore, the Examiner is respectfully requested to withdraw this rejection.

### **III. SUBSTANCE OF THE INTERVIEW**

Interview conducted on July 28, 2004, the following was discussed:

1. *Identification of claims discussed:*

Independent claims 1 and 6.

2. *Identification of prior art discussed:*

Dawson and Hata

3. *Identification of principal proposed amendments:*

Applicant's representative discussed the proposed editorial amendments set forth in a proposed amendment provided to the Examiner at the personal interview. The proposed editorial amendments are identical to the editorial amendments set forth in this current Amendment.

4. *Brief identification of principal arguments:*

Applicant's representative explained the invention and discussed the traversal arguments set forth in the current Amendment.

5. *Results of the Interview:*

The Examiner indicated that neither Dawson nor Hata taught or suggested a "light trapping member" as recited by the claimed invention. However, the Examiner indicated that it was necessary to amend the claims to overcome the rejections.

#### **IV. NEW CLAIMS**

New claims 7-26 are added to provide more varied protection for the present invention and to claim additional features of the invention. These claims are independently patentable because of the novel features recited therein.

Applicant respectfully submits that new claim 7-26 are patentable over any combination of the applied references at least for analogous reasons to those set forth above with respect to claims 1, 2 and 6.

#### **V. FORMAL MATTERS AND CONCLUSION**

In response to Examiner's objections, the claims have been amended in a manner believed fully responsive to all points raised by the Examiner.

In view of the foregoing, Applicant submits that claims 1-2 and 6-26, all of the claims presently pending in the application, are patentably distinct over the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time.

Should the Examiner find the application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary in a telephonic or personal interview.

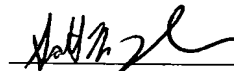
Serial No. 10/694,811  
Docket No. PTGF-03081  
HIR.079

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The Commissioner is hereby authorized to charge any deficiency in fees or to credit any overpayment in fees to Attorney's Deposit Account No. 50-0481.

Respectfully Submitted,

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